Technology Corner

UDOT Research News

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Using Ultrasonic Waves To Clean Sieves

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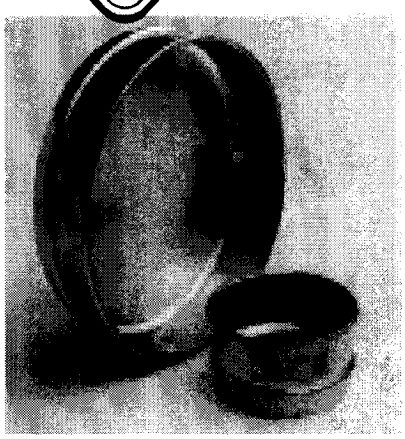

The Department shows national leadership in applying technology to solve problems that were previously unsolvable. Our Construction-Materials Division came up with a way to clean heretofore uncleanable laboratory testing sieves, so that they can be reused rather than be discarded. By soaking in an ultrasonic warm-water bath for only about two minutes, a fine-mesh sieve can be cleaned 100% without damaging its delicate fabric. As ultrasonic waves travel through water, vibrating at 40 thousand times per second, they shake loose foreign particles trapped in the wire cloth of the sieve. This method uses no caustic chemicals and is environmentally friendly. Formerly, sieves with openings 850 micro-meters (#20 or 20 holes per inch) or smaller had to be discarded because of an accumulation of tiny particles of soil and aggregate that became wedged in the holes of the fabric. The Department saved over a thousand dollars in just the first week's use of the ultrasonic bath.

Sieves are used in soil and aggregate size analysis in the Construction/Materials Division's central labs, in all four region labs, and in all field labs in order to control quality of highway pavement material, base material that supports the pavement, and the soil in the ground underneath. The quality of the material that goes into building our state highways in turn is reflected in how much the Department pays the contractor. Litigations arise over quality control. Sieves used in state highway construction are required to be tested periodically and certified by the Department's Certification Lab at the Rampton Complex. Certification means that a sieve has been tested under very careful scrutiny, using high-tech electronic equipment, to make sure that it meets the rigid guidelines of ASTM E-11 Standards.

A typical brass or stainless sieve looks like a round cake pan. Except the bottom, instead of being solid, is

made of tightly stretched woven wire cloth with a uniform pattern of square holes throughout. Very thick wire is used for sieves with large-size holes, usually 2 to 3 inch (50 to 75 mm) openings. Very delicate wire (thinner than a human hair) is used for the smallest sieves, typically #200 or 200 openings per inch (0.075 mm). Sieves are stacked with the largest openings on top and the smallest on the bottom. Percentages of a soil sample that remain on each sieve, after a few minutes of mechanical shaking, are compared with highway design criteria. Poor quality soil and aggregate mix are cause for that phase of construction to halt until the problem is corrected.

Larger size sieves, openings larger than #20 or 20 openings per inch (0.85 mm), can be cleaned with a wire brush without damaging the wire. However, sieves with openings #20 and smaller have such delicate wire cloth, that brushing will damage the cloth and render it useless. Especially susceptible to clogging are sieves with the smallest openings. Particles of clay or silt, almost smaller than the human eye can see create a brown haze-like cloud on a #200 screen perhaps only after 10 soil samples, depending on soil composition. Finer sieves, costing over $100 each, often had to be discarded and replaced after just a few tests.

During the month of January 1999, laboratory tests by the division showed the following conclusions:

1 Conventional cleaning methods (chemicals, compressed air, steam, brushing) damage fine-mesh sieves.

2.Optimum cleaning was achieved, using 40-kHz ultrasonic generators with a power level of 1000 Watts per 20 gallons of warm water. No damage to any ultrasonically cleaned sieve has been detected since the Certification lab started using this process. Adding about one tablespoon of liquid dish soap per each 10 gal of water accelerates the cleaning.

3.The ultrasonic system cost $7500 and has paid for itself in the first three months. Annual savings for the department amount to $35,000 or more.

4.This method works on many other applications, such as hardened cement on laboratory cement molds, greasy machine parts (even the interior).

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